

## ABSTRACT

A reliable high frequency VCSEL includes a lower distributed Bragg reflector (DBR), an active region, and an upper DBR. A cylindrical volume is etched from the upper DBR to define a mesa with a lower surface of the cylindrical volume forming an angle greater than ninety degrees with the side wall of the mesa. An isolation trench is etched in the lower surface of the cylindrical volume concentric with the mesa and extending through the active region. A portion of the side wall of the mesa and the lower surface of the cylindrical volume are proton implanted. The upper DBR is planarized using low- $k$  dielectric materials and  $n$  and  $p$  electrical contacts are coupled to opposite sides of the active region for supplying operating current thereto.